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(54) **COMPRESSOR**

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CPC ***F04B 15/00*** (2013.01); ***F04C 18/02*** (2013.01); ***F04C 18/0215*** (2013.01); ***F04C 29/026*** (2013.01)

(58) **Field of Classification Search**
CPC F04C 18/02; F04C 18/0215; F04C 29/026
USPC 417/313; 55/459.1, 462, 450, 451
See application file for complete search history.

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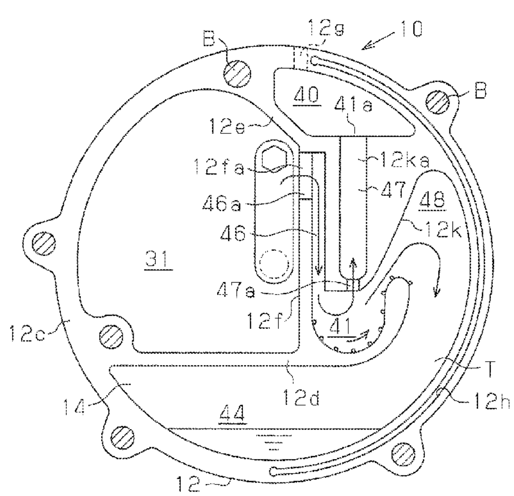
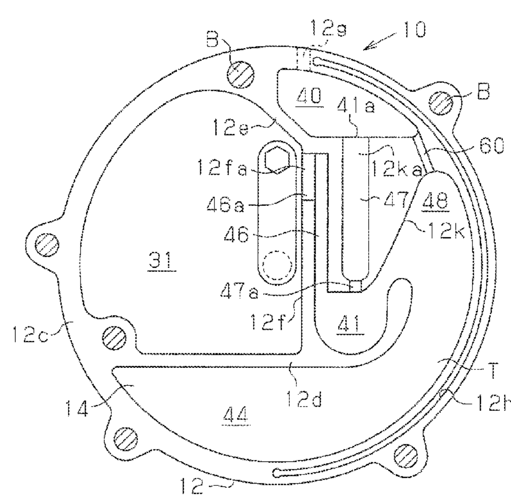
(57) **ABSTRACT**

A compressor includes a housing, compression unit, discharge chamber, outlet, and oil separation structure. The oil separation structure, which is arranged between the discharge chamber and the outlet, includes an oil reservoir, oil separation compartment, intake passage, exhaust passage, and supply passage. The oil separation compartment is located upward from the oil reservoir. The intake passage, which extends upward from the oil separation compartment, draws refrigerant gas into the oil separation compartment from the discharge chamber to separate lubrication oil from the refrigerant gas. The exhaust passage extends upward from the oil separation compartment and discharges the refrigerant gas in the oil separation compartment out of the housing through the outlet. The supply passage extends upward from the oil separation compartment and has a larger cross-sectional area than the intake passage. The supply passage supplies the oil reservoir with lubrication oil from the oil separation compartment.

11 Claims, 6 Drawing Sheets





(51) **Int. Cl.**

F04C 29/02	(2006.01)
F04C 18/02	(2006.01)

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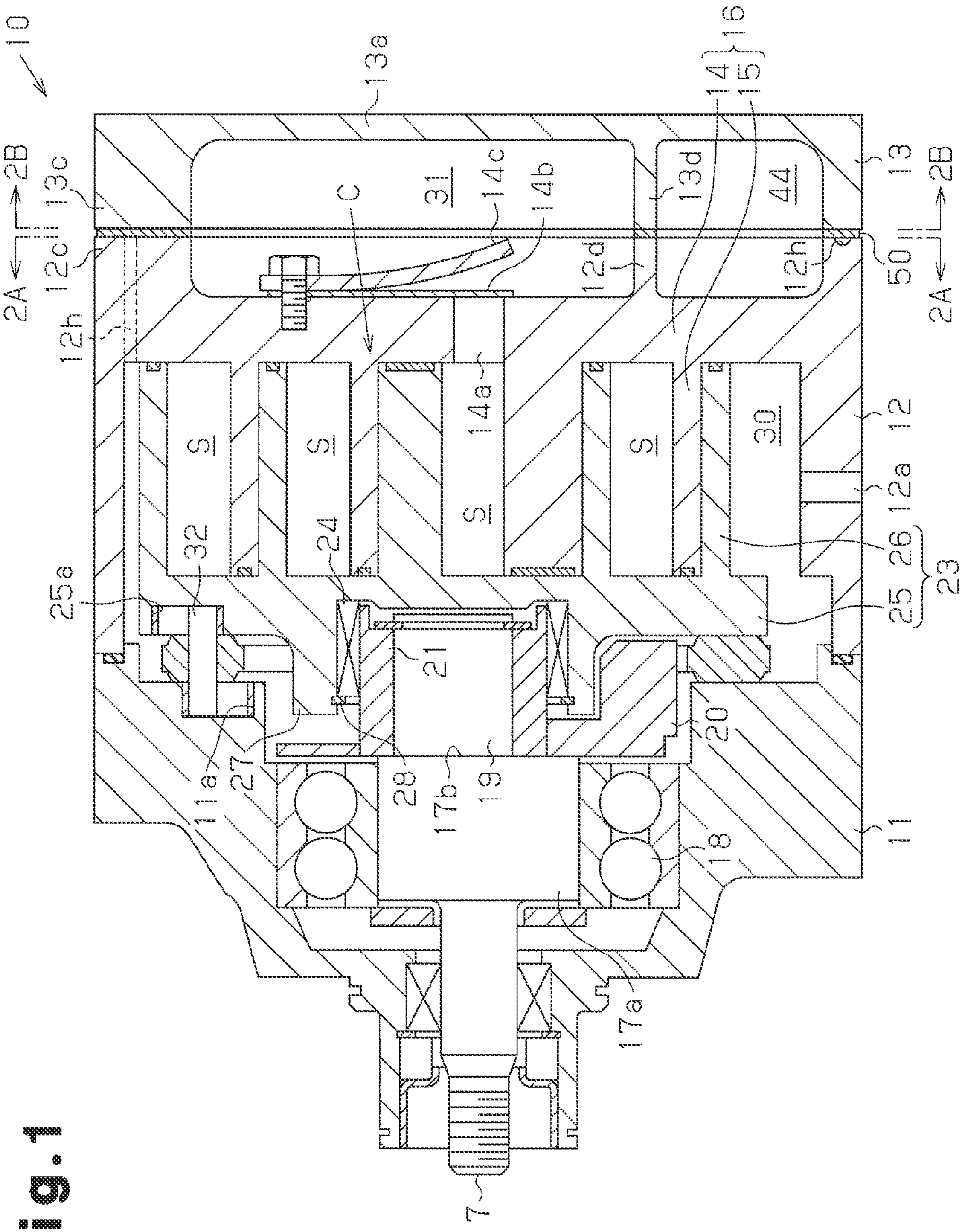
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Fig.1

Fig.2A

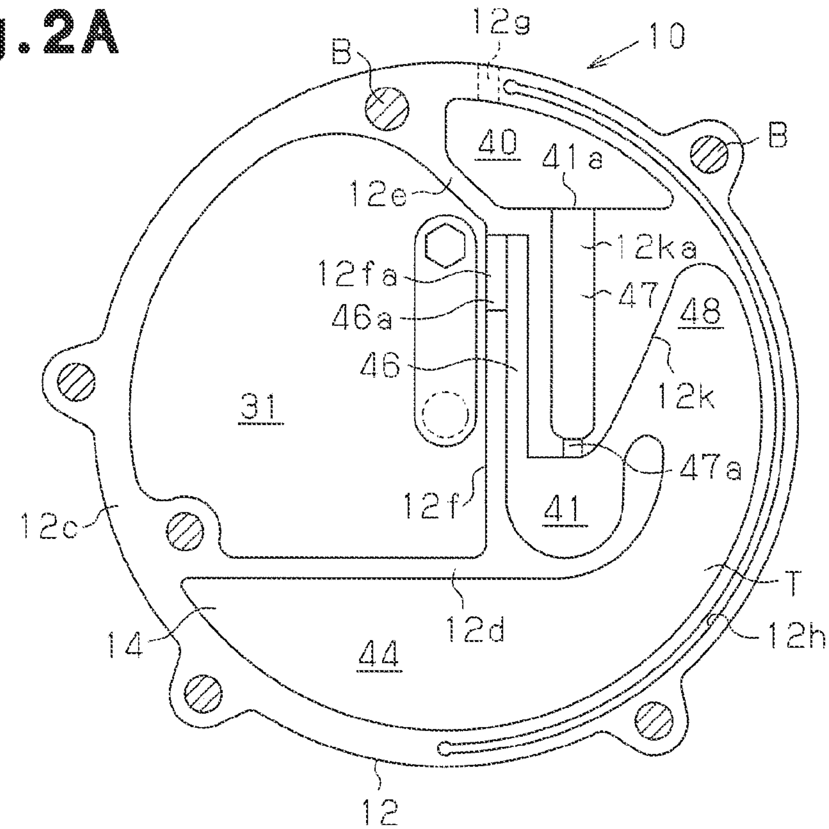
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Fig.2B

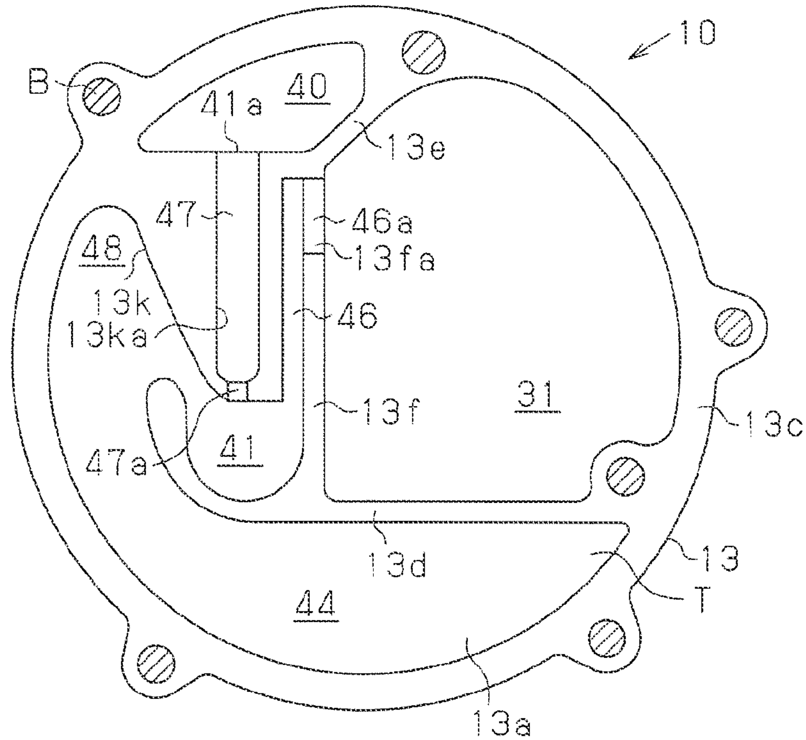
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Fig.3

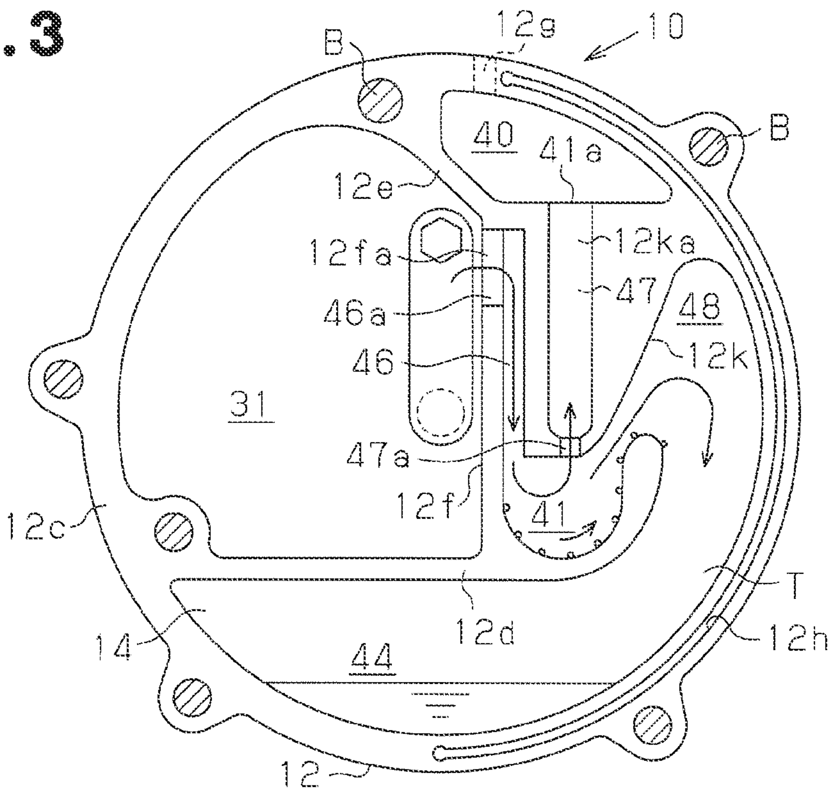
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Fig.4

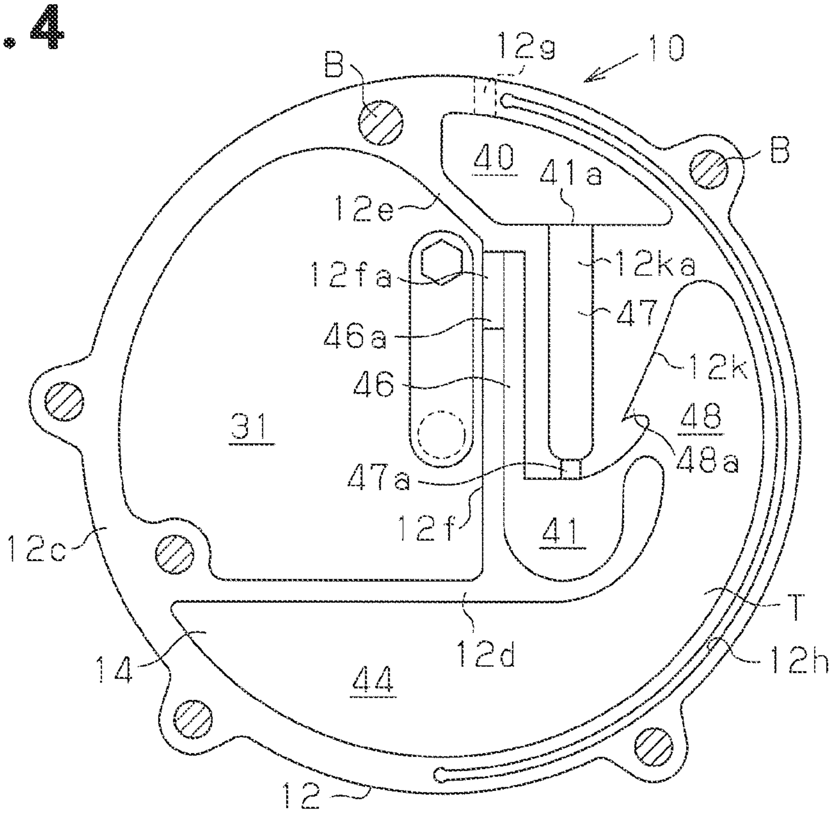
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Fig.5

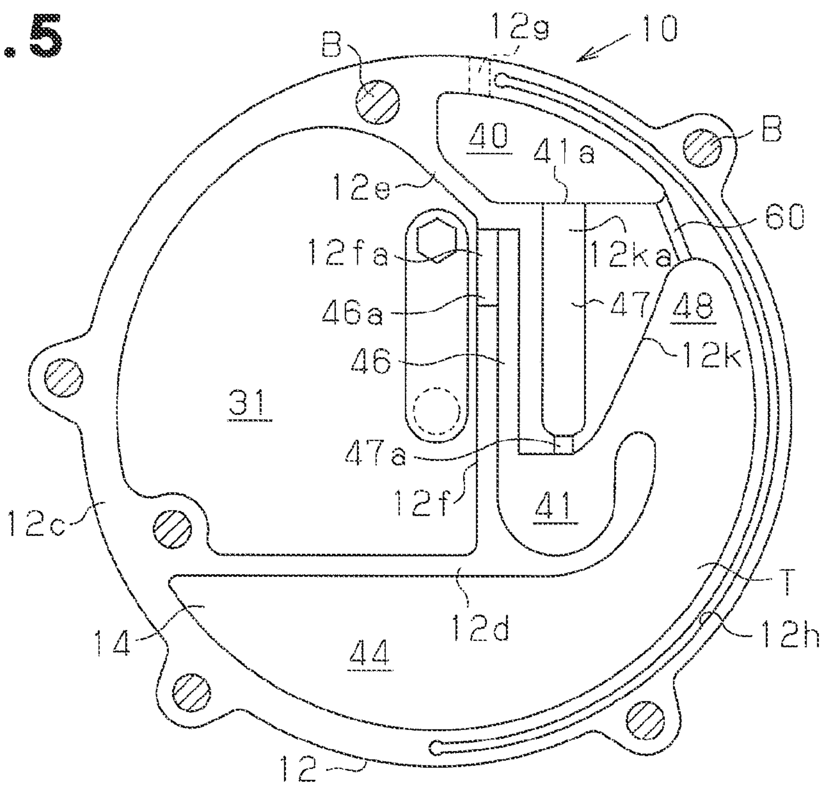
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Fig.6

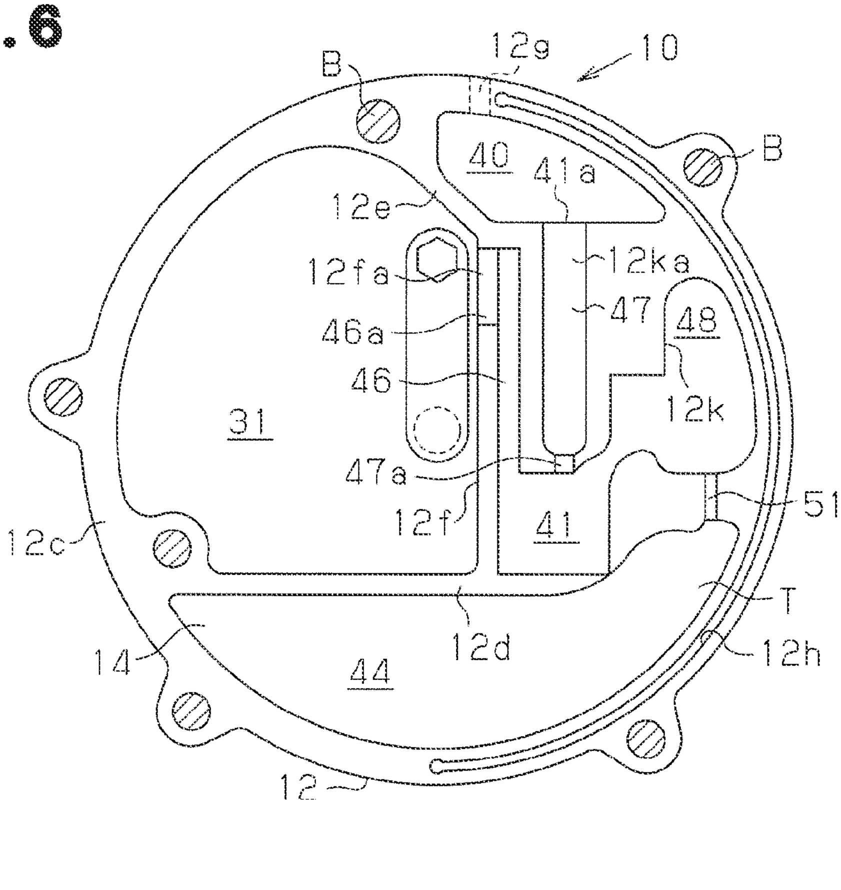
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Fig.7

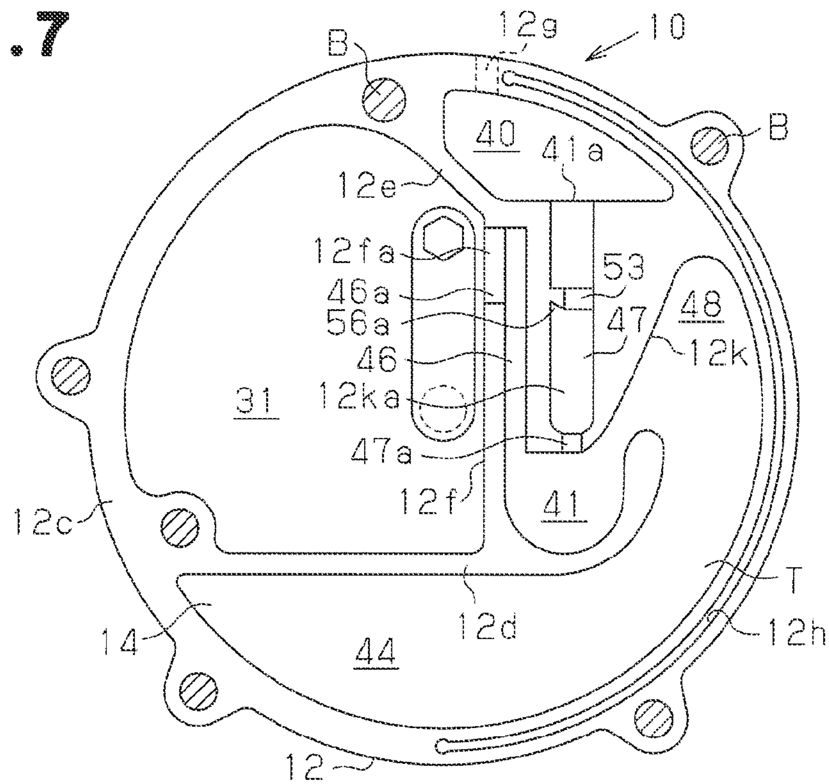
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Fig.8

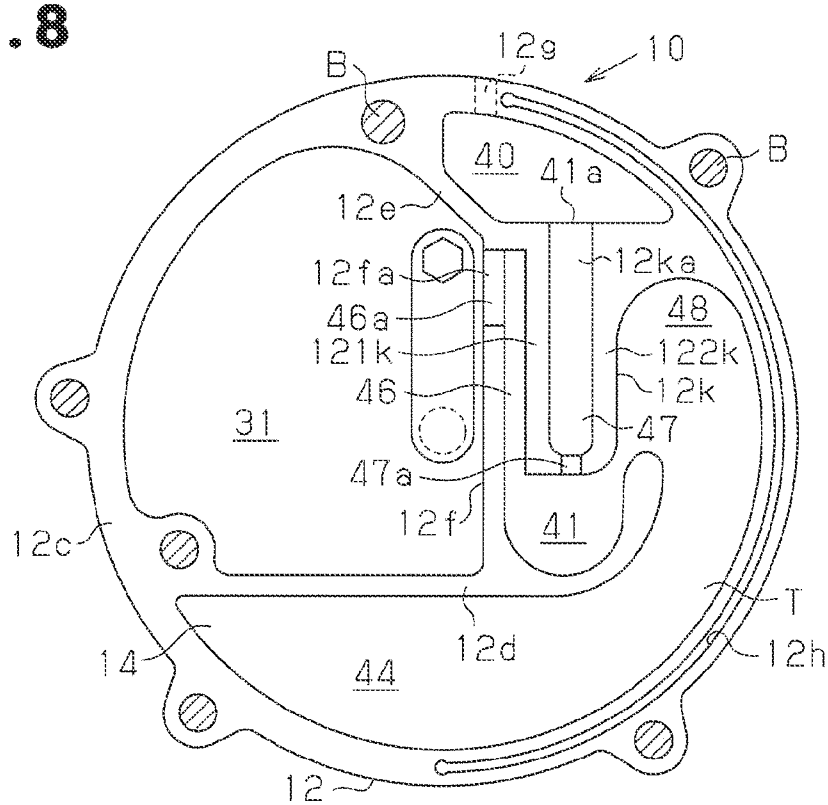
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Fig.9A(Prior Art)

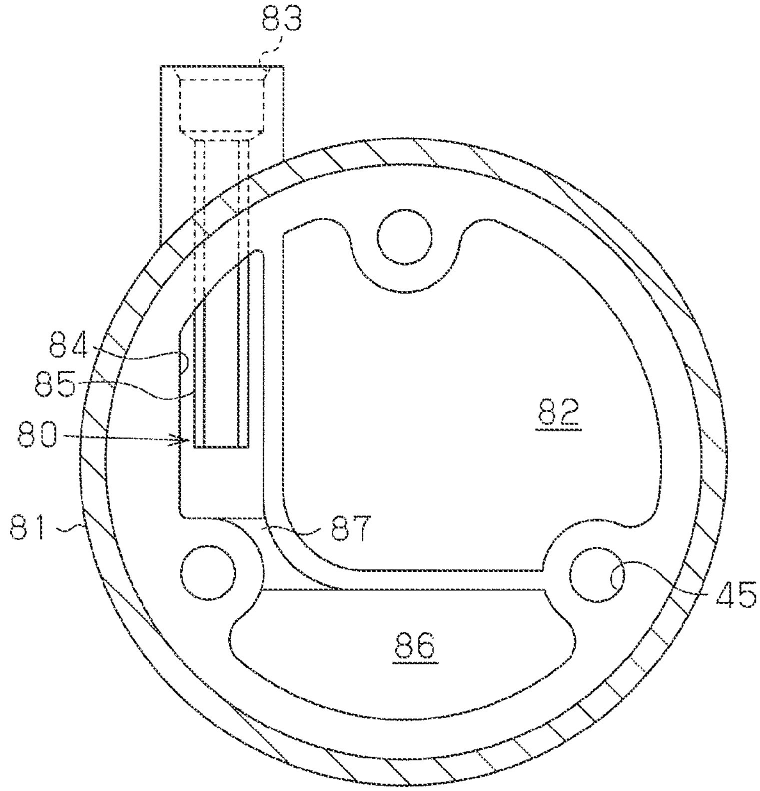
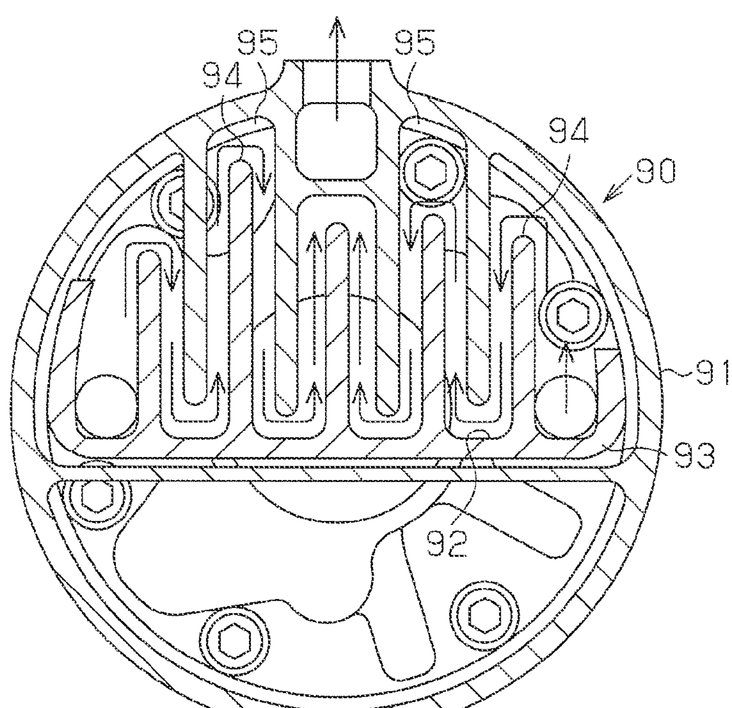


Fig.9B(Prior Art)



COMPRESSOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to Japanese Patent Application No. 2012-067753 filed Mar. 23, 2012.

BACKGROUND

The present invention relates to a compressor provided with a housing including a compression unit, which draws in refrigerant gas, compresses the refrigerant gas, and then discharges the refrigerant gas from a discharge chamber through an outlet and out of the housing, and an oil separation structure, which is arranged between the discharge chamber and the outlet to separate lubrication oil from the refrigerant gas.

A typical compressor for a vehicle air conditioner uses lubrication oil, which is suspended in a refrigerant gas, to lubricate parts such as a compression mechanism when the refrigerant gas circulates through the housing of the compressor. Thus, such a compressor includes an oil separation mechanism, which is arranged in a discharge line, to confine the lubrication oil to the compressor and prevent the lubrication oil from escaping into an external refrigerant circuit together with the refrigerant gas. Japanese Laid-Open Patent Publication No. 2005-320873 describes an example of a whirling type oil separation structure. Referring to FIG. **9**A, in Japanese Laid-Open Patent Publication No. 2005-320873, an oil separator **80** is arranged in a compression casing **81** between a discharge chamber **82** and an outlet **83**. The oil separator **80** includes a separation compartment **84** and a separation tube **85**. The separation tube **85** is press-fitted into and fixed to the separation compartment **84**. An annular void is formed between the wall surface of the separation compartment **84** and the outer surface of the separation tube **85**. An oil passage **87**, which is in communication with an oil reservoir **86**, is formed below the separation compartment **84**.

The refrigerant gas in the discharge chamber **82** enters the separation compartment **84** of the oil separator **80**. The refrigerant gas then whirls around the outer surface of the separation tube **85** as it descends in the separation compartment **84**. This applies centrifugal force to the refrigerant and separates lubrication oil from the refrigerant gas. The lubrication oil collects on the wall surface of the separation compartment **84**. Then, the refrigerant gas flows through the separation tube **85** and is discharged out of the outlet **83**.

Japanese Laid-Open Patent Publication No. 2009-235910 describes an example of an impingement type oil separation structure. Referring to FIG. **9**B, a gas compressor **90** described in Japanese Laid-Open Patent Publication No. 2009-235910 includes a casing **91** that accommodates a compression mechanism (not shown) and a baffling passage **92**, through which compressed refrigerant gas flows. The baffling passage **92** is formed by staggering a series of fin-shaped baffles **94** between the casing **91** and an opposing portion of a rear block **93**. An oil reservoir (not shown) that accumulates separated lubrication oil is arranged between the casing **91** and the rear block **93**.

When refrigerant gas flows through the baffling passage **92**, the refrigerant gas repetitively impinges against bent portions **95** formed between the baffles **94**. The difference in specific gravity separates lubrication oil from the refrigerant gas. The refrigerant gas is discharged out of the gas compressor **90**, whereas the lubrication oil is accumulated in the oil reservoir.

In the whirling type oil separation structure such as the oil separator **80** of Japanese Laid-Open Patent Publication No. 2005-320873 that uses a separation tube **85**, the separation tube **85** should have a particular length and diameter to whirl the refrigerant gas about the separation tube **85** in a preferable manner and obtain the required performance for separating lubrication oil. Thus, there is a tendency for the oil separation structure to be large, and the freedom of layout is thereby limited.

In the impingement type oil separation structure such as that of Japanese Laid-Open Patent Publication No. 2009-235910 that uses the baffling passage **92**, the baffling passage **92** should have a particular length and a particular number of bent portions **95** to induce refrigerant gas impingement against the bent portions **95** a desired number of times. Thus, the oil separation structure tends to be large. Further, as the lubrication oil separated from the baffling passage **92** meanders through the baffling passage **92**, the lubrication oil may fill the baffling passage **92**. In this case, the lubrication oil may flow backward to the compression mechanism, and the lubrication oil may be carried by the refrigerant gas to the external refrigerant circuit.

SUMMARY

It is an object of the present invention to provide a compressor that allows an oil separation mechanism to be reduced in size, have a higher freedom of layout, and impede the escape of lubrication oil from the compressor.

To achieve the above object, one aspect of the present invention is a compressor including a housing, a compression unit, a discharge chamber, an outlet, and an oil separation structure. The compression unit is arranged in the housing and draws in, compresses, and discharges refrigerant gas. The discharge chamber is in communication with the compression unit. The outlet is in communication with the discharge chamber. The outlet is formed in the housing to discharge the refrigerant gas out of the housing. The oil separation structure, which is arranged between the discharge chamber and the outlet, separates lubrication oil from the refrigerant gas and accumulates separated lubrication oil. The oil separation structure includes an oil reservoir that accumulates the lubrication oil separated from the refrigerant gas. An oil separation compartment is located upward from the oil reservoir and is in communication with the oil reservoir. An intake passage extends upward from the oil separation compartment and is in communication with the discharge chamber. The intake passage draws the refrigerant gas from the discharge chamber into the oil separation compartment to separate the lubrication oil from the refrigerant gas. An exhaust passage extends upward from the oil separation compartment and is in communication with the outlet. The exhaust passage discharges the refrigerant gas from the oil separation compartment through the outlet and out of the housing. A supply passage extends upward from the oil separation compartment and has a larger cross-sectional area than the intake passage. The supply passage supplies the separated lubrication oil from the oil separation compartment to the oil reservoir.

In the above structure, refrigerant gas is drawn from the discharge chamber through the intake passage and into the oil separation compartment. The intake passage increases the flow velocity of the refrigerant gas. When the refrigerant gas, of which the flow velocity has been increased, blows into the oil separation compartment, the lubrication oil suspended in the refrigerant gas remains on the wall surface of the oil separation compartment due to surface tension. Thus, the refrigerant gas separated from the lubrication oil is drawn into the exhaust passage, which is in communication with the outlet, and discharged from the oil separation compartment out of the housing. In this manner, the oil separation compartment separates refrigerant gas and lubrication oil and impedes the escape of the separated lubrication oil out of the housing and into the exterior.

Further, the supply passage has a larger cross-sectional area than the intake passage. Thus, the lubrication oil separated in the oil separation compartment does not clog the supply passage and can be smoothly supplied from the oil separation compartment to the supply passage. Moreover, the lubrication oil collected on the wall surface of the oil separation compartment is conveyed along the wall surface and supplied to the supply passage. Since the supply passage extends upward from the oil separation compartment, the velocity of the lubrication oil decreases as it moves along the wall surface. This prevents the lubrication oil from the supply passage from entering the oil reservoir with great force. In this manner, the oil separation structure includes three passages in communication with the oil separation compartment. The passages have different cross-sectional areas, adjust the flow velocity of the refrigerant gas, and adjust the direction in which the lubrication oil flows. This efficiently separates the lubrication oil and impedes the escape of lubrication oil to the exterior. In addition to the oil separation compartment and the oil reservoir, the oil separation structure merely extends three passages upward from the oil separation compartment. This efficiently separates lubrication oil, and the oil separation structure, which efficiently separates lubrication oil from refrigerant gas, can be reduced in size in the vertical direction.

The oil separation structure of the present invention can separate lubrication oil from refrigerant gas in the passages and compartments of the housing. Thus, there is no need for a separation tube like in a whirling type oil separation structure. Further, in the oil separation structure of the present invention, there is no need for a baffling passage used for refrigerant gas impingement and the arrangement of a large number of impingement sections like in an impingement type oil separation structure. Thus, the compressor of the present invention allows for reduction in size of the oil separation structure as compared with a whirling type or impingement type oil separation structure. This increases the freedom of layout for the compressor.

Preferably, the intake passage, the exhaust passage, and the supply passage are arranged next to one another. Further, the exhaust passage is arranged between the intake passage and the supply passage.

In the above structure, the refrigerant gas flows from the discharge chamber through the intake passage and into the oil separation compartment, which separates lubrication oil from the refrigerant gas. Then, the refrigerant gas is discharged from the oil separation compartment. Further, the exhaust passage is located next to the intake passage. Thus, the refrigerant gas is readily transferred to the exhaust passage. In the oil separation compartment, the lubrication oil is conveyed along the wall surface toward the supply passage. The supply passage is farthest from the intake passage. Thus, the oil separation compartment efficiently separates refrigerant gas and lubrication oil when the lubrication oil is conveyed along the wall surface.

Preferably, the exhaust passage includes an inlet, which is in communication with the oil separation compartment, and a large diameter portion, which is located at a downstream side of the inlet and has a larger cross-sectional area than the inlet.

In the above structure, the flow velocity of the refrigerant gas, which is drawn into the exhaust passage, decreases at the large diameter portion. Thus, even when lubrication oil is suspended in the refrigerant gas that is drawn into the exhaust passage, the lubrication oil can be separated from the refrigerant gas when passing through the exhaust passage.

Preferably, the oil separation compartment includes a bottom surface that is recessed in an arcuate manner.

In the above structure, the refrigerant gas, which is drawn into the oil separation compartment, whirls along the bottom surface of the oil separation compartment. This separates lubrication oil from the refrigerant gas.

Preferably, part of the supply passage, which extends from the oil separation compartment, forms a backflow preventing portion that extends back toward the oil separation compartment.

In the above structure, when lubrication oil is conveyed along the wall surface of the supply passage, even if the lubrication oil flows back toward the oil separation compartment, the lubrication oil flows into the backflow preventing portion. This decreases the amount of lubrication oil that flows backward from the supply passage to the oil separation compartment.

Preferably, the oil separation structure includes a bypass passage that communicates the supply passage with a portion of the oil separation structure that is located closer to the exhaust passage than the outlet.

In the above structure, the refrigerant gas that passes through the exhaust passage enters a portion of the oil separation structure located closer to the exhaust passage than the outlet. Here, the lubrication oil carried out of the oil separation compartment is separated from the refrigerant gas. The separated lubrication oil is returned to the supply passage through the bypass passage.

Preferably, the oil separation structure includes a throttle arranged between the supply passage and the oil reservoir.

In the above structure, even when refrigerant gas flows into the supply passage, the throttle prevents the refrigerant gas from flowing into the oil reservoir with great force.

Preferably, the exhaust passage includes a throttle and a trap. The throttle is recessed in the exhaust passage in a direction intersecting a direction in which the refrigerant gas flows through the exhaust passage. The trap is located in a portion of the exhaust passage that is closer to the oil separation compartment than the throttle. The trap has a larger cross-sectional area than the throttle.

In the above structure, when lubrication oil is carried into the exhaust passage and conveyed along the wall surface of the exhaust passage, the lubrication oil enters the trap. This prevents the lubrication oil from flowing further downstream from the throttle.

Preferably, the housing includes a first wall, which partitions the intake passage and the exhaust passage, and a second wall, which partitions the exhaust passage and the supply passage. The first wall and the second wall extend parallel to each other.

In the above structure, the supply passage extends generally straight upward from the oil separation compartment. This ensures that the lubrication oil separated in the oil separation compartment in decreased in velocity when conveyed along the wall surface of the oil separation compartment. Thus, lubrication oil is prevented from entering the supply passage with great force.

Preferably the compressor further includes a suction chamber, which draws in the refrigerant gas, and an oil supply communication passage, which communicates the suction chamber and the oil reservoir.

In the above structure, after the oil separation structure separates lubrication oil from the refrigerant gas, the lubrication oil can be returned through the oil supply communication passage to the suction chamber, which has a lower pressure than the oil reservoir. Thus, the lubrication oil separated from the refrigerant gas is returned to the refrigerant gas to lubricate the compression unit and the like in a state suspended in the refrigerant gas. Accordingly, the lubrication oil lubricates the compression unit and the like, and the lubrication oil is not carried out of the housing.

Preferably, the housing includes a plurality of housing formation members. The oil separation compartment and the oil reservoir are formed by coupling the housing formation members.

In this structure, the oil separation compartment and oil reservoir are formed over a plurality of housing formation members. This allows for an increase in the volumes of the oil separation compartment and oil reservoir in comparison to when they are formed in, for example, only one housing formation member. Further, the oil separation compartment and oil reservoir can be formed by coupling the housing formation members in a state opposed to each other. This facilitates the manufacturing of the oil separation structure and lowers the cost of the compressor.

Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. **1** is a cross-sectional view showing a compressor according to one embodiment of the present invention;

FIG. **2**A is a cross-sectional view taken along line **2**A-**2**A in FIG. **1**;

FIG. **2**B is a cross-sectional view taken along line **2**B-**2**B in FIG. **1**;

FIG. **3** is a cross-sectional view showing an oil separation structure of the compressor of FIG. **1**;

FIG. **4** is a diagram showing another example of a supply passage of FIG. **3**;

FIG. **5** is a diagram showing an example of a bypass passage that communicates an outlet and the supply passage;

FIG. **6** is a diagram showing an example of a throttle arranged between the supply passage and an oil reservoir;

FIG. **7** is a diagram showing an example of a trap arranged in an exhaust passage;

FIG. **8** is a diagram showing another example of an oil separation structure including parallel partition walls;

FIG. **9**A is a cross-sectional view showing a whirling type oil separation mechanism; and

FIG. **9**B is a cross-sectional view showing an impingement type oil separation structure.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

A scroll compressor **10**, which is one embodiment of a compressor according to the present invention, will now be described with reference to FIGS. **1** to **4**.

As shown in FIGS. **1** and **2**, the scroll compressor **10** is provided with a housing including a center housing **12** (shell), which has a first end and second end, a front housing **11**, which is coupled to the first end of the center housing **12**, and a rear housing **13**, which is coupled to the second end of the center housing **12**. The front housing **11**, center housing **12**, and rear housing **13** are fastened together by fasteners B. The front housing **11**, center housing **12**, and rear housing **13** each define a housing formation member that forms the housing of the compressor **10**.

As shown in FIG. **1**, the housing of the scroll compressor **10** includes a scroll type compression unit C that compresses refrigerant gas. In detail, the center housing **12** is cylindrical and includes a closed end and an open end, which faces the front housing **11**. A fixed scroll **16**, which forms the compression unit C, is fixed in the center housing **12**. The fixed scroll **16** includes a fixed base plate **14**, which forms the closed end of the center housing **12**, and a fixed spiral wall **15**, which extends from the fixed base plate **14** toward the front housing **11**.

A rotation shaft **17**, which includes a large diameter portion **17***a*, is arranged in the front housing **11**. A radial bearing **18** supports the large diameter portion **17***a* in a rotatable manner. The large diameter portion **17***a* includes an end face **17***b* that is proximal to the fixed scroll **16**. An eccentric shaft **19** is formed integrally with the end face **17***b*. The eccentric shaft **19** has an axis separated from that of the rotation shaft **17**.

The eccentric shaft **19** supports a balance weight **20** and bushing **21**, which are rotatable relative to each other. A movable scroll **23**, which forms the compression unit C, is supported by a bearing **24** on the bushing **21**. The movable scroll **23** is rotatable relative to the bushing **21** and faces the fixed scroll **16**. The movable scroll **23** includes a movable base plate **25** that faces the fixed base plate **14**. A movable spiral wall **26**, which is fitted to the fixed spiral wall **15**, projects from the movable base plate **25**.

A compression chamber S having a variable volume is formed in between the fixed base plate **14** and fixed spiral wall **15** of the fixed scroll **16** and the movable base plate **25** and movable spiral wall **26** of the movable scroll **23**. The fixed base plate **14** includes a discharge port **14***a*, which is in communication with the compression chamber S. A discharge valve **14***b* is fixed to the fixed base plate **14** to open and close the discharge port **14***a*. A retainer **14***c* is fixed to the fixed base plate **14** to restrict the open amount of the discharge valve **14***b*.

The center housing **12** and rear housing **13** form a discharge chamber **31**, which is in communication with the discharge port **14***a*. A suction chamber **30**, which serves as a suction portion of the compression unit C, is defined between the circumferential wall of the center housing **12** and the outermost portion in the movable spiral wall of the movable scroll **23**. Accordingly, the suction chamber **30** is arranged in the outer section of the compression unit C. Further, the circumferential wall of the center housing **12** includes a suction port **12***a*, which is in communication with the suction chamber **30**.

The end face of the front housing **11** includes a plurality of rotation restriction holes **11** a arranged near the circumference of the movable base plate **25** along the circumferential direction of the movable base plate **25**. The movable base plate **25** also includes rotation restriction holes **25***a* arranged along the circumferential direction of the movable base plate **25**. The number of the rotation restriction holes **25***a* is the same as the number of the rotation restriction holes **11***a*. Ends of rotation restriction pins **32** are inserted into the rotation restriction holes **25***a*.

The rotation of the rotation shaft **17** and the eccentric shaft **19** produces an orbiting motion of the movable scroll **23**. Refrigerant gas, which is drawn through the suction port **12***a* into the suction chamber **30**, enters the gaps between the fixed base plate **14** and the movable base plate **25**. As the movable scroll **23** orbits, the circumferential surface of each rotation restriction pin **32** slides along the wall surfaces of the rotation restriction holes **11***a* and **25***a*. Thus, the movable scroll **23** orbits without rotating. Further, the orbiting of the movable scroll **23** converges the compression chamber S toward inner terminal ends of the spiral walls **15** and **26** in the two scrolls **16** and **23**, while decreasing the volume of the compression chamber S. The decrease in the volume of the compression chamber S compresses the refrigerant gas, which is discharged out of the discharge port **14***a* and into the discharge chamber **31**.

As shown in FIG. **3**, when the center housing **12** and rear housing **13** are coupled, a muffler compartment **40**, an oil separation compartment **41**, an oil reservoir **44**, an intake passage **46**, an exhaust passage **47**, and a supply passage **48** are formed in the housing.

As shown in FIG. **2**A, the fixed base plate **14** in the center housing **12** includes an annular center housing circumferential wall **12***c*, which projects toward the rear housing **13** from the circumference of the fixed base plate **14**. Further, as shown in FIG. **2**B, the rear housing **13** includes a closed end **13***a*. An annular rear housing circumferential wall **13***c* projects from the circumference of the closed end **13***a* toward the center housing circumferential wall **12***c*. As shown in FIG. **1**, in a state in which the center housing **12** and rear housing **13** are coupled to each other, a gasket **50** is held between the center housing **12** and rear housing **13**. The gasket **50** impedes the leakage of refrigerant gas and lubrication oil from the muffler compartment **40**, the oil separation compartment **41**, the oil reservoir **44**, the exhaust passage **47**, and the supply passage **48**.

As shown in FIGS. **2**A and **2**B, a vertically lower portion in the fixed base plate **14** includes a first wall **12***d*, which extends laterally from a portion of the center housing circumferential wall **12***c* and then curves upward. Further, a vertically lower portion in the closed end **13***a* of the rear housing **13** includes a first wall **13***d*, which extends laterally from part of the rear housing circumferential wall **13***c* and then curves upward. In this manner, the first wall **13***d* includes a distal portion that is arcuate and curved upward.

A vertically upper portion in the fixed base plate **14** includes a second wall **12***e*, which connects two locations on the center housing circumferential wall **12***c*. The fixed base plate **14**, the second wall **12***e*, and the center housing circumferential wall **12***c* encompass a void that forms a part of the muffler compartment **40**. Further, a partition wall **12***k* (partition) extends from the second wall **12***e* toward the first wall **12***d*. A clearance is formed between a distal end of the partition wall **12***k* and the first wall **12***d*. The partition wall **12***k* includes a hollow passage formation portion **12***ka*, which extends in the vertical direction.

As shown in FIG. **2**B, a vertically upper portion in the closed end **13***a* of the rear housing **13** includes a second wall **13***e*, which connects two locations on the rear housing circumferential wall **13***c*. The closed end **13***a*, second wall **13***e*, and rear housing circumferential wall **13***c* encompass a void that forms part of the muffler compartment **40**. Further, a partition wall **13***k* (partition) extends from the second wall **13***e* toward the first wall **13***d*. A clearance is formed between a distal end of the partition wall **13***k* and the first wall **13***d*. The partition wall **13***k* includes a hollow passage formation portion **13***ka*, which extends in the vertical direction.

Referring to FIG. **3**, the center housing **12** and rear housing **13** are coupled, and the two muffler compartments **40** are joined with each other. Thus, a single muffler compartment **40** is formed in the housing. The muffler compartment **40** is in communication with an outlet **12***g*, which is formed in the center housing circumferential wall **12***c*. The outlet **12***g* leads to the exterior of the housing.

As shown in FIG. **2**A, the fixed base plate **14** includes a third wall **12***f* that extends in the vertical direction and connects the first wall **12***d* and second wall **12***e*. The third wall **12***f* has a clearance of a fixed distance from the partition wall **12***k*. Part of the intake passage **46** is formed between the fixed base plate **14**, third wall **12***f*, and partition wall **12***k*. An intake port formation recess **12***fa* is formed in an upper portion of the third wall **12***f*. The fixed base plate **14**, center housing circumferential wall **12***c*, first wall **12***d*, second wall **12***e*, and third wall **12***f* encompass a void that forms part of the discharge chamber **31**. Further, the fixed base plate **14**, distal portion of the first wall **12***d*, third wall **12***f*, partition wall **12***k*, and center housing circumferential wall **12***c* encompass part of a continuous oil separation void T.

As shown in FIG. **2**B, the closed end **13***a* of the rear housing **13** includes a third wall **13***f* that extends in the vertical direction and connects the first wall **13***d* and the second wall **13***e*. The third wall **13***f* has a clearance of a fixed distance from the partition wall **13***k*. Part of the intake passage **46** is formed between the closed end **13***a*, the third wall **13***f*, and the partition wall **13***k*. An intake port formation recess **13***fa* is formed in an upper portion of the third wall **13***f*. The closed end **13***a*, the rear housing circumferential wall **13***c*, the first wall **13***d*, the second wall **13***e*, and the third wall **13***f* encompass a void that forms part of the discharge chamber **31**. Further, the closed end **13***a*, the distal portion of the first wall **13***d*, the third wall **13***f*, the partition wall **13***k*, and the rear housing circumferential wall **13***c* encompass part of a continuous oil separation void T.

Referring to FIG. **3**, when the center housing **12** and rear housing **13** are coupled to each other, the two discharge chambers **31** are joined with each other to form a single discharge chamber **31** in the housing. Further, when the center housing **12** and the rear housing **13** are coupled to each other, the two intake passages **46** are joined with each other to form a single intake passage **46** in the housing. The intake port formation recesses **12***fa* and **13***fa* are also joined with each other thereby forming an intake port **46***a*, which communicates the discharge chamber **31** and the intake passage **46**. Additionally, when the center housing **12** and rear housing **13** are coupled to each other, the two passage formation portions **12***ka* and **13***ka* are joined with each other to form the exhaust passage **47** in the housing.

The two oil separation voids T are joined with each other to form a single oil separation void T in the housing. The oil separation void T includes a section forming the oil separation compartment **41** that is located below the intake passage **46** and exhaust passage **47** and encompassed by the distal portions of the first walls **12***d* and **13***d*. The oil separation void T also includes a section forming the supply passage **48**, which extends diagonally upward from the oil separation compartment **41**. Further, the oil separation void T includes a section forming the oil reservoir **44** that is located downward from the supply passage **48** and below the first walls **12***d* and **13***d*. The intake passage **46**, oil separation compartment **41**, exhaust passage **47**, supply passage **48**, and oil reservoir **44** form an oil separation structure arranged between the discharge chamber **31** and the outlet **12***g*.

The intake passage **46**, exhaust passage **47**, oil separation compartment **41**, supply passage **48**, and oil reservoir **44** will now be described in detail.

The intake passage **46** includes one end in communication with the discharge chamber **31** through the intake port **46***a* and another end in communication with the oil separation compartment **41**. Accordingly, the intake passage **46** extends upward from the oil separation compartment **41** and is in communication with the discharge chamber **31**. The intake passage **46** has a smaller diameter (i.e., cross-sectional area) than the discharge chamber **31**. Refrigerant gas is drawn from the discharge chamber **31** through the intake port **46***a* into the intake passage **46**.

Upper surfaces of the first walls **12***d* and **13***d* form a bottom surface of the oil separation compartment **41**. The bottom surface is recessed in an arcuate manner. Thus, the lubrication oil drawn into the oil separation compartment **41** from the intake passage **46** is conveyed along the arcuate bottom surface of the oil separation compartment **41**, and the refrigerant gas whirls along the bottom surface of the oil separation compartment **41**.

The exhaust passage **47** includes one end, which is in communication with the oil separation compartment **41**, and another end, which is in communication with the muffler compartment **40**. Accordingly, the exhaust passage **47** extends upward from the oil separation compartment **41** and is in communication with the muffler compartment **40**. The end of the exhaust passage **47** that is in communication with the oil separation compartment **41** defines an inlet **47***a* into which refrigerant gas flows from the oil separation compartment **41**. The portion of the exhaust passage **47** other than the inlet **47***a* forms a large diameter portion having a larger diameter (i.e., cross-sectional area) than the inlet **47***a*. The refrigerant gas drawn into the oil separation compartment **41** enters the inlet **47***a* of the exhaust passage **47**. Then, the refrigerant gas expands at the large diameter portion. This decreases the flow velocity of the refrigerant gas. In this state, the refrigerant gas enters the muffler compartment **40**.

The supply passage **48** extends upward from the oil separation compartment **41**. More specifically, the supply passage **48** extends diagonally upward from the intake passage **46** at the oil separation compartment **41**. Thus, the lubrication oil in the oil separation compartment **41** is conveyed diagonally upward along the wall surface of the oil separation compartment **41** and supplied to the supply passage **48**. The supply passage **48** has a larger diameter (i.e., cross-sectional area) than the intake passage **46** and the exhaust passage **47** (inlet **47***a*). The intake passage **46**, exhaust passage **47**, and supply passage **48** are arranged in this order from the discharge chamber **31**, and the exhaust passage **47** is arranged between the intake passage **46** and the supply passage **48**.

The oil reservoir **44** is arranged below the supply passage **48**. The oil reservoir **44** is a compartment for accumulating the lubrication oil that falls from the supply passage **48**. As shown in FIG. **3**, the supply passage **48** is arranged in the housing extending diagonally upward from the oil separation compartment **41**, that is, in a direction intersecting the vertical direction of the oil separation compartment **41**. Further, the oil reservoir **44** is arranged in the housing to extend downward from beside the oil separation compartment **41**. The discharge chamber **31** is arranged diagonally upward from the oil separation compartment **41**. As shown in FIGS. **1** and **2**A, the center housing circumferential wall **12***c* of the center housing **12** includes an oil supply communication passage **12***h*, which communicates the oil reservoir **44** and the suction chamber **30**. The oil supply communication passage **12***h* extends over one half of the center housing circumferential wall **12***c*.

The operation of the scroll compressor **10** will now be described.

The refrigerant gas compressed in the compression unit C and discharged into the discharge chamber **31** enters the intake passage **46** through the intake port **46***a* and is drawn into the oil separation compartment **41** through the intake passage **46**. The refrigerant gas is forced from the intake passage **46**, which has a small diameter, into the oil separation compartment **41**, which is a vast void, thereby increasing the flow velocity of the refrigerant gas. Thus, turbulence of the refrigerant gas is suppressed in the intake passage **46**. Further, the refrigerant gas flows toward the oil separation compartment **41** in a laminar state at a substantially uniform velocity and blows into the oil separation compartment **41** through the outlet of the intake passage **46**.

In the oil separation compartment **41**, due to surface tension, lubrication oil is conveyed along the wall surface of the oil separation compartment **41**. The refrigerant gas forces the lubrication oil on the wall surface of the oil separation compartment **41** away from the intake passage **46**. Thus, the lubrication oil is conveyed along the bottom surface of the oil separation compartment **41** toward the supply passage **48**. In the oil separation compartment **41**, the refrigerant gas is directed upward along the bottom surface of the oil separation compartment **41** and drawn into the exhaust passage **47**, which is in communication with the outlet **12***g*. Thus, the refrigerant gas forced into the oil separation compartment **41** is readily discharged from the exhaust passage **47** into the muffler compartment **40**. Then, the refrigerant gas is discharged from the muffler compartment **40** through the outlet **12***g* and out of the housing of the scroll compressor **10**.

The lubrication oil conveyed along the wall surface of the oil separation compartment **41** is directly supplied to the supply passage **48**. The supply passage **48** has a larger diameter (i.e., cross-sectional area) than the intake passage **46** and the exhaust passage **47**. This prevents the supply passage **48** from being filled with lubrication oil and smoothly supplies the supply passage **48** with lubrication oil. Then, the lubrication oil of the oil reservoir **44** is supplied through the oil supply communication passage **12***h* to the suction chamber **30**.

The above embodiment has the advantages described below.

(1) The oil separation structure of the scroll compressor **10** includes the oil reservoir **44** in the housing and the oil separation compartment **41**, which is located above the oil reservoir **44**. Further, the intake passage **46**, the exhaust passage **47**, and the supply passage **48** extend upward from the oil separation compartment **41**. The intake passage **46** is in communication with the discharge chamber **31**, and the exhaust passage **47** is in communication with the outlet **12***g*. The supply passage **48** is in communication with the oil reservoir **44**. The intake passage **46** has a smaller diameter (i.e., cross-sectional area) than the supply passage **48** and functions as a throttle. Thus, when refrigerant gas flows through the intake passage **46** and enters the oil separation compartment **41**, the flow velocity of the refrigerant gas is increased in the intake passage **46**. Further, the refrigerant gas forced into the oil separation compartment **41** is drawn into the exhaust passage **47**, which is in communication with the outlet **12***g*, and discharged from the oil separation compartment **41**. As a result, the lubrication oil suspended in the refrigerant gas remains collected on the wall surface of the oil separation compartment due to surface tension. Further, lubrication oil is efficiently separated from the refrigerant gas, and the escape of lubrication oil from the housing of the scroll compressor **10** together with refrigerant gas is impeded.

Further, there is no need for a separation tube that whirls the refrigerant gas to separate lubrication oil from the refrigerant gas. The oil separation structure efficiently separates lubrication oil from the refrigerant gas by merely arranging the oil separation compartment **41** above the oil reservoir **44** and extending the three passages **46**, **47**, and **48** from the oil separation compartment **41**. This allows for reduction in the size of the oil separation structure, which extends in the vertical direction in the housing. Additionally, the oil separation structure can be reduced in size in comparison with when using a whirling type oil separation structure. Further, the location of the outlet **12***g* is not determined by the location of the separation tube, and the outlet **12***g* may be located in any position. This increases the freedom of layout for the scroll compressor **10**.

Moreover, there is no need for a baffling passage used for refrigerant gas impingement and the arrangement of multiple impingement sections like in an impingement type oil separation structure. This allows for reduction in the size of the oil separation structure and a decrease in the energy loss that results from the impingement of refrigerant gas.

Additionally, the supply passage **48** has a larger diameter (i.e., cross-sectional area) than the intake passage **46** and has a large volume. Thus, the lubrication oil separated from the refrigerant gas in the oil separation compartment **41** does not clog the supply passage **48** when being transferred through the supply passage **48**. This smoothly supplies the separated lubrication oil from the oil separation compartment **41** to the supply passage **48**. Further, the supply passage **48** extends upward from the oil separation compartment **41**. Thus, when the lubrication oil separated in the oil separation compartment **41** is transferred along the wall surface of the oil separation compartment **41** toward the supply passage **48**, the velocity of the lubrication oil falls. This prevents the lubrication oil from entering the supply passage **48** with great force, and the supply of the separated lubrication oil prevents the oil surface from being disturbed in the oil reservoir **44**. Further, sufficient volume can be ensured for the supply passage **48**. Thus, the lubrication oil does not overflow from the supply passage **48**, and the lubrication oil in the supply passage **48** is prevented from flowing backward to the oil separation compartment.

(2) In the oil separation structure of the scroll compressor **10**, the intake passage **46** has a smaller diameter (i.e., cross-sectional area) than the supply passage **48** and functions as a throttle. Thus, when the refrigerant gas flows through the intake passage **46**, the refrigerant gas is prevented from becoming turbulent, and refrigerant gas is allowed to flow toward the oil separation compartment **41** at a generally constant flow velocity. This suppresses the collection of lubrication oil on the wall surface of the intake passage **46** that would occur when the refrigerant gas is turbulent, and most of the lubrication oil can be separated in the oil separation compartment **41**.

(3) The inlet **47***a*, which is connected to the oil separation compartment **41** in the exhaust passage **47**, is narrowed, and the portion of the exhaust passage **47** located toward the outlet **12***g* from the inlet **47***a* has a larger diameter. Thus, the large diameter portion decreases the flow velocity of the refrigerant gas drawn into the exhaust passage **47**. If the flow velocity were to remain high in the exhaust passage **47**, the lubrication oil would be carried by the refrigerant gas from the exhaust passage **47** to the muffler compartment **40** and then out of the scroll compressor **10**. However, the decrease in the flow velocity impedes the escape of lubrication oil from the scroll compressor **10**. Further, the decrease in the flow velocity of the refrigerant gas results in lubrication oil collecting more easily on the wall surface of the exhaust passage **47**, and the lubrication oil can be separated when passing through the exhaust passage **47**.

(4) The bottom surface of the oil separation compartment **41** is arcuate and curved from the intake passage **46** toward the supply passage **48**. Thus, the flow of refrigerant gas, which blows into the oil separation compartment **41**, along the bottom surface of the oil separation compartment **41** whirls refrigerant gas in the oil separation compartment **41**. As a result, the whirling in the oil separation compartment **41** allows for centrifugal force to separate lubrication oil from the refrigerant gas, which blows into the oil separation compartment **41**. Thus, in the oil separation compartment **41**, the collection of lubrication oil on the wall surface and the centrifugal separation of the lubrication oil caused by the whirling can be efficiently performed.

(5) The bottom surface of the oil separation compartment **41** is arcuate and curved from the intake passage **46** to the supply passage **48**. Thus, the lubrication oil collected on the wall surface proximal to the inlet of the oil separation compartment **41** is conveyed along the bottom surface of the oil separation compartment **41** and directly supplied to the supply passage **48**.

(6) The oil separation compartment **41**, the oil reservoir **44**, and the supply passage **48** are formed by coupling the center housing **12** and the rear housing **13**. Thus, the oil separation compartment **41**, the oil reservoir **44**, and the supply passage **48** extend over the two housings **12** and **13**. This allows each of the oil separation compartment **41**, the oil reservoir **44**, and the supply passage **48** to have a larger volume as compared to when they are formed in, for example, only the rear housing **13**. Further, the oil separation compartment **41** and the oil reservoir **44** can be formed merely by coupling the center housing **12** and the rear housing **13** in a state opposed to each other. This allows for the oil separation structure and, ultimately, the scroll compressor **10** to be easily manufactured with low costs.

(7) The oil separation structure of the scroll compressor **10** includes the intake passage **46**, which is in communication with the discharge chamber **31**, and the oil separation compartment **41**, which is in communication with the intake passage **46**. Further, the supply passage **48** and exhaust passage **47** are formed in communication with the oil separation compartment **41**, and the oil reservoir **44** is formed in communication with the supply passage **48**. By setting the diameters (i.e., cross-sectional area) of the intake passage **46** and supply passage **48** and the extending directions of the passages, lubrication oil can be efficiently separated from the refrigerant gas. Accordingly, the oil separation structure of the present embodiment completely differs from a structure in which a passage having a uniform diameter is merely meandered or a structure in which refrigerant gas merely impinges against sections of a passage.

(8) The intake passage **46**, exhaust passage **47**, and supply passage **48** are arranged in this order from the discharge chamber **31** in the housing. The exhaust passage **47** is arranged between the intake passage **46** and the supply passage **48**. Thus, the refrigerant gas supplied from the intake passage **46** to the oil separation compartment **41** can readily be discharged from the exhaust passage **47** out of the oil separation compartment **41**.

It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

In the above embodiment, the oil separation compartment **41**, the oil reservoir **44**, the intake passage **46**, the exhaust passage **47**, and the supply passage **48** extend over the center housing **12** and the rear housing **13**. However, the oil separation compartment **41**, the oil reservoir **44**, the intake passage **46**, the exhaust passage **47**, and the supply passage **48** may be formed in only the rear housing **13** or the center housing **12**.

As shown in FIG. **4**, part of the supply passage **48** may be expanded to form a backflow preventing portion **48***a* that extends back toward the oil separation compartment **41** from the supply passage **48**. More specifically, part of the partition walls **12***k* and **13***k* are cut out toward the oil separation compartment **41**, and the cut out portion forms the backflow preventing portion **48***a*. In this structure, when lubrication oil flows along the wall surface of the supply passage **48**, even if the lubrication oil flows backward toward the oil separation compartment **41**, the lubrication oil would enter the backflow preventing portion **48***a*. This decreases the amount of lubrication oil that flows backward from the supply passage **48** to the oil separation compartment **41**.

As shown in FIG. **5**, a bypass passage **60** may communicate the muffler compartment **40**, which is a portion closer to the exhaust passage **47** than the outlet **12***g*, and the supply passage **48**. In the muffler compartment **40**, the refrigerant gas from the exhaust passage **47** expands. In this state, even when the lubrication oil escapes from the oil separation compartment **41**, the expansion of the refrigerant gas in the muffler compartment **40** separates lubrication oil from the refrigerant gas. The separated lubrication oil in the muffler compartment **40** can be returned to the supply passage **48** through the bypass passage **60**. This impedes the escape of lubrication oil from the housing of the scroll compressor **10**.

As shown in FIG. **6**, a throttle **51** may be arranged between the supply passage **48** and the oil reservoir **44**. In this structure, even when refrigerant gas flows to the supply passage **48**, the throttle **51** prevents the refrigerant gas from flowing into the oil reservoir **44** with great force and prevents the refrigerant gas from disturbing the oil surface in the oil reservoir **44**.

The bottom surface of the oil separation compartment **41** does not have to be recessed in an arcuate manner. For example, as shown in FIG. **6**, the oil separation compartment **41** may be box-shaped.

As shown in FIG. **7**, the exhaust passage **47** may include a throttle **53** formed by recessing the exhaust passage **47** in a direction intersecting the flow direction of the refrigerant gas in the exhaust passage **47**. A trap **56***a*, which has a larger diameter than the throttle **53**, is formed in the portion of the exhaust passage **47** closer to the oil separation compartment **41** than the throttle **53** of the exhaust passage **47**. That is, the trap **56***a* is located at the upstream side of the throttle **53** in the exhaust passage **47**. In this manner, the exhaust passage **47** includes the trap **56***a* and the throttle **53**, which are formed continuously in the flow direction of the refrigerant gas, and the throttle **53** is formed at the downstream side of the trap **56***a*. The throttle **53** is formed by reducing the diameter of the exhaust passage **47** in a tapered manner toward the oil separation compartment **41**. The trap **56***a* extends along the circulation direction of the refrigerant gas in the exhaust passage **47**.

In this structure, when lubrication oil is conveyed along the wall surface of the exhaust passage **47**, the lubrication oil enters the trap **56***a*. This decreases the amount of lubrication oil flowing to the muffler compartment **40** and impedes the escape of lubrication oil out of the scroll compressor **10**.

As shown in FIG. **8**, in the partition walls **12***k* and **13***k*, portions (first walls **121***k*) partitioning the intake passage **46** and the exhaust passage **47** may be formed parallel to portions (second wall **122***k*) partitioning the exhaust passage **47** and the supply passage **48**. In this case, the exhaust passage **47** extends backward at 180 degrees from the intake passage **46**. Further, part of the supply passage **48** extends backward at 180 degrees from the intake passage **46**.

In this structure, part of the supply passage **48** (portion of the supply passage **48** proximal to the oil separation compartment **41**) extends straight upward. This further ensures a decrease in the velocity of the lubrication, which is separated from the refrigerant gas in the oil separation compartment **41**, conveyed along the wall surface of the oil separation compartment **41** toward the supply passage **48** and prevents the lubrication oil from entering the supply passage **48** with great force.

In the above embodiment, the intake passage **46**, exhaust passage **47**, and supply passage **48** are arranged in order from the discharge chamber **31**. However, the arrangement order of the intake passage **46**, exhaust passage **47**, and supply passage **48** may be changed.

In the above embodiment, the compression unit C is of a scroll type. Instead, the compression unit C may be of a vane type.

The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

What is claimed:

1. A compressor comprising:

a housing;

a compression unit arranged in the housing, wherein the compression unit draws in, compresses, and discharges refrigerant gas;

a discharge chamber in communication with the compression unit;

an outlet in communication with the discharge chamber, wherein the outlet is formed in the housing to discharge the refrigerant gas out of the housing; and

an oil separation structure arranged between the discharge chamber and the outlet, wherein the oil separation structure separates lubrication oil from the refrigerant gas and accumulates separated lubrication oil, and the oil separation structure includes:

an oil reservoir that accumulates the lubrication oil separated from the refrigerant gas,

an oil separation compartment that is located upward from the oil reservoir and is in communication with the oil reservoir,

an intake passage that extends upward from the oil separation compartment and is in communication with the discharge chamber, wherein the intake passage draws the refrigerant gas from the discharge chamber into the oil separation compartment to separate the lubrication oil from the refrigerant gas,

an exhaust passage that extends upward from the oil separation compartment and is in communication with the outlet, wherein the exhaust passage discharges the refrigerant gas from the oil separation compartment through the outlet and out of the housing, and

a supply passage that extends upward from the oil separation compartment and has a larger cross-sectional area than the intake passage, wherein the supply passage supplies the separated lubrication oil from the oil separation compartment to the oil reservoir.

2. The compressor according to claim **1**, wherein

the intake passage, the exhaust passage, and the supply passage are arranged next to one another, and

the exhaust passage is arranged between the intake passage and the supply passage.

3. The compressor according to claim **1**, wherein the exhaust passage includes an inlet, which is in communication with the oil separation compartment, and a large diameter portion, the large diameter portion is located at a downstream side of the inlet and has a larger cross-sectional area than the inlet.

4. The compressor according to claim **1**, wherein the oil separation compartment includes a bottom surface that is recessed in an arcuate manner.

5. The compressor according to claim **1**, wherein part of the supply passage, which extends from the oil separation compartment, forms a backflow preventing portion that extends back toward the oil separation compartment.

6. The compressor according to claim **1**, wherein the oil separation structure includes a bypass passage that communicates the supply passage with a portion of the oil separation structure that is located closer to the exhaust passage than the outlet.

7. The compressor according to claim **1**, wherein the oil separation structure includes a throttle arranged between the supply passage and the oil reservoir.

8. The compressor according to claim **1**, wherein the exhaust passage includes

a throttle recessed in the exhaust passage in a direction intersecting a direction in which the refrigerant gas flows through the exhaust passage, and

a trap located in a portion of the exhaust passage that is closer to the oil separation compartment than the throttle, and

the trap has a larger cross-sectional area than the throttle.

9. The compressor according to claim **1**, wherein the housing includes

a first wall that partitions the intake passage and the exhaust passage, and

a second wall that partitions the exhaust passage and the supply passage,

wherein the first wall and the second wall extend parallel to each other.

10. The compressor according to claim **1**, further comprising:

a suction chamber that draws in the refrigerant gas; and

an oil supply communication passage that communicates the suction chamber and the oil reservoir.

11. The compressor according to claim **1**, wherein

the housing includes a plurality of housing formation members, and

the oil separation compartment and the oil reservoir are formed by coupling the housing formation members.

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